COIL SPRING DESIGN

Assume torsional modules of elasticity.

Load = 80lb., Mean Spring Diameter = 1.5", C = 11, 500,000 psi.

Assume allowable working stress's = 60,000 psi

$d = 3\frac{PD}{0.3S}$ $\quad d = \sqrt[3]{\frac{80\# \times 1.5"}{.3 \times 60{,}000 \text{ psi.}}} = .188"$ Try No. 6 wire = .192 inches

Find Wahl Factor $K = \frac{4C-1}{4C-4} + \frac{0.615}{C}$ Trial wire size $C = \frac{D}{d} = \frac{1.5}{.192} = 7.8$ inches = Wahl Factor

$S = \frac{8PDK}{(d)^3} = \frac{8x80x1.5.1.19}{3.1416 \times (.192)^3}$ = 51,500 psi stress less than 60,000 psi

Use # 7 Wire

$f = \frac{(8PD)^3}{Gx(d)^4} = \frac{8x80x(1.5)^3}{11{,}500{,}000x\,(0.177)^4} = 0.191"$

Assume clearance between loaded coils = 1/16"

Then Pitch = L = B + f + d = 1/16" + .0191 + .192" = 0.444"

Clearance = B = L - f - d + 0.444" - 0.191 - 0.177" = .076"

Assume Solid Length is less than 1 - 7/16"

Number of coils = $N = \frac{h}{d} = \frac{1.43"}{0.177"}$ = 8 active coils

Therefore Solid Length = h = 8 x 0.177 = 1.4"

Free Length = H = 8 x 0.444" = 3.5"

Pitch L Per Coil = of Loaded Spring = l

Pitch l per coil = L - f = 0.444 - 0.191 = 0.253"/coil

COIL SPRING DESIGN, P.2

Assume Hw = 2.5" and end coils are squared.

$$N = \text{number of active coils} = \frac{Hw-3d}{1} = \frac{2.5"-3 \times .177}{.253} = 8 \text{ coils}$$

When N = 8

$$H = 8 \times .444" + 3 \times 0.177 = 4.1"$$

Total Deflection = N = (L-d) = 8 (.444" - .177") = 2.136"

Working load: Working Deflection: Maximum Load: Maximum Deflection

Maximum Working Load = 2.136" x 80lb/1.53" = 112 pounds

$$\text{Solid height load } P = \frac{11{,}500{,}000 \times (0.177)^4 \times 2.136}{8 \times 8 \times (1.5)^3} = 112 \text{ pounds}$$

Working Stress: Maximum Stress: Working Deflection: Maximum Deflection

$$\text{Maximum Stress } S = \frac{64{,}500 \text{ psi} \times 112\#}{80\#} = 90{,}000 \text{ psi}$$

The Ratio of Mean Spring Diameter to Wire Diameter, i.e., the "Spring Index" should be between 6 and 9, wherein 9 is ideal.